REMARKS

Applicants respectfully request that the following amendments be entered at least because they raise no new issues that would require further search or consideration, and because they place the application in condition for allowance.

Claims 1 and 10 are amended.

A detailed listing of all claims that are, or were, in the application, irrespective of whether the claim(s) remain under examination in the application, is presented, with an appropriate defined status identifier. Claims 1, 3-10, 12, 14-18 and 20-25 remain pending in this application.

Rejections under 35 U.S.C. § 103

Claims 1, 3-12, 14-18 and 20-23 stand rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,693,203 to Ohhashi et al. (hereafter "Ohhashi"). Claims 24-25 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Ohhashi in view of acknowledged prior art on page 2, lines 1-24 (hereafter "the APA"). Applicants respectfully traverse these rejections for at least the following reasons.

Claims 1 and 18

Claims 1 and 18 cannot reasonably be interpreted to include a zero amount of Ta and oxygen, respectively, as an impurity. The plain meaning of the language of these claims precludes such an interpretation, such an interpretation is inconsistent with the specification and file history, and one skilled in the art would not reasonably interpret claims 1 and 18 to include a zero amount of Ta and oxygen, respectively.

The plain meaning of the language of claims 1 and 18 precludes a reasonable interpretation of these claims to include a zero amount of Ta and oxygen, respectively. Claims 1 and 18 require that the Nb target contain "an amount of Ta as an impurity, the amount of Ta in the target being 3000 ppm or less", and "an amount of oxygen as an impurity, the oxygen content in the target being 200 ppm or less", respectively. Because the

target contains an amount of Ta (or oxygen) as an impurity, the target must contain *some* Ta (or oxygen), even though the claims set no express lower bound to the amount range. It has long been established PTO practice, accepted by the courts, that the claim language "an amount of X less than _____ %" positively specifies that X is present in the composition in some amount, i.e., greater than zero.

The Office Action alleges that the "recited O and Ta contents read on zero which suggests said elements could be eliminated from the sputtering targets." Applicants submit that a zero content of Ta and oxygen in claims 1 and 18, respectively, is not a reasonable interpretation of these claims and is not consistent with the specification, the file history, or with the interpretation of one skilled in the art.

A zero content of Ta and oxygen in claims 1 and 18, respectively, is not consistent with the meaning of impurity in the specification. Ta and oxygen are inevitable impurities in Nb sputtering targets, and thus cannot be readily eliminated therefrom. In this regard, the present specification on page 7, lines 16-22, recites as follows:

> Since Nb and Ta are in an adjacent relationship in the periodic table, Nb raw material necessarily contains Ta. These Nb and Ta are generally called refractory metals and, being together 5A group elements, have very similar properties. Accordingly, it is not easy to separate Ta from Nb and resultantly ordinary Nb material contains relatively large amount of Ta as an impurity element. (emphasis added).

Accordingly, it is difficult to completely separate Ta from Nb, and it is unavoidable that available Nb material for a sputtering target contains some amount of Ta. Similarly, oxygen inevitably exists as an impurity in some amount in a Nb sputtering target.

A zero content of Ta and oxygen in claims 1 and 18, respectively, is not consistent with the file history for the present application. Applicants have stressed repeatedly that a reasonable interpretation of claims 1 and 18 precludes the target of these claims containing a zero amount of Ta and oxygen, respectively.

A zero content of Ta and oxygen in claims 1 and 18, respectively, is also contrary to the interpretation of one skilled in the art. In support, applicants file herewith a declaration

under 35 C.F.R. § 1.132 by one of the inventors, Koichi Watanabe, of the presently claimed invention. As declared by Mr. Watanabe in the declaration, one skilled in the art would not reasonably interpret claims 1 and 18 to contain a zero amount of Ta and oxygen, respectively. These claims require that an amount of Ta and oxygen be contained in the target, and further that Ta and oxygen be contained as an *impurity*. One skilled in the art would reasonably require that the claims contain *some* amount of these impurities, since as an impurity these elements could not readily be eliminated.

As an example of the difficulty in completely removing the impurities of Ta and oxygen from Nb, the declaration refers to JP 62-103335 (submitted in the Information Disclosure Statement filed on December 29, 2000 in the present application), which discloses super high purity Nb having an excellent workability for a superconductive material and which contains 30 ppm or less of Ta and 10 ppm or less of each of oxygen, carbon, nitrogen and hydrogen, which is produced by a high quality manufacturing method. Thus, Ta and oxygen exist as impurities in Nb even for super high purity Nb produced by high quality manufacturing methods. One skilled in the art would reasonably interpret claims 1 and 18 as requiring some amount of Ta and oxygen impurity, respectively, because these impurities exist even in super high purity Nb.

In sum, because Ta and oxygen are inevitable impurities in a Nb sputtering target, the contention in the Office Action that the oxygen and Ta content of the Takahashi Nb sputtering target could be eliminated is simply incorrect, and claims 1 and 18, reasonably interpreted, require some amount of Ta and oxygen, respectively.

Ohhashi fails to suggest that the impurities of Ta and oxygen can be totally eliminated from a Nb sputtering target, or how this would be accomplished. Ohhashi is directed to sputtering targets generally, not to producing Nb sputtering target with very low impurities of Ta and oxygen.

The Office Action asserts that Ohhashi discloses the target material could be elemental Nb without an alloying element such as Ta. This statement misses the point. At best Ohhashi discloses that in some embodiments Ta is not intentionally included in a Nb

target as an alloying element. Significantly, what Ohhashi does not disclose is any attempt to remove Ta from the Nb as an impurity.

Moreover, claims 1 and 18 require a specific dispersion of Ta and oxygen in the sputtering target, which is not suggested in Takahashi. Claims 1 and 18 recite, respectively, that the dispersion of the Ta content in the target is within 30%, and that the dispersion of the oxygen content in the target is within 80%. The Office Action suggests that a zero content of Ta or oxygen would result in a zero % content dispersion. Applicants submit that even if this were accurate (which it is not) claims 1 and 18 exclude a zero content of Ta or oxygen. Thus, Takahashi fails to suggest the dispersion recited in claims 1 and 18.

The Office Action continues to (as in prior Office Actions) ground its reasoning for obviousness in part on the principle that "optimization of a variable *recognized in the art as a result-effective variable* normally is considered to be within the ordinary skill in the art." Again, while Applicants do not quarrel with the statement of the general principle, they do point out that the present record is devoid of any evidence that those skilled in this art recognized that the claimed parameters were "result-effective" for the results sought after by the Applicants. Ohashi fails to teach or suggest the peculiar problems of a Nb target caused by the existence of Ta and oxygen as inevitable impurities, or the electrical characteristics of the wiring formed by such a Nb target. The specific Ta and oxygen content in claims 1 and 18 provide solutions to problems recognized by the inventors of the present application, while Takahashi fails to recognize the content of Ta or oxygen as a result-effective variable, much less provide the solution as recited in claims 1 and 18.

Claim 10

Claim 10 is directed to a Nb sputtering target and recites parameters concerning the grain diameter size of a Nb target that allows for suppressed occurrence of dust when sputtering. Claim 10 recites an average grain diameter of 100μm or less, a grain diameter in the range of 0.1 to 10 times an average grain diameter, and a dispersion of the grain size ratio of adjacent grains within 30%.

As the result of extensive investigation of the occurrence of giant dust particles generated from Nb targets, and the relation between Nb grains constituting the target and the giant dust particles, applicants found that when an average grain diameter is 100 μm or less, each grain has a diameter in the range of 0.1 to 10 times the average grain diameter, a grain size ratio of adjacent grains is in the range of 0.1 to 10, and a dispersion of the grain size ratio of adjacent grains in the target is within 30%, the occurrence of giant dust particles can be effectively suppressed.

Ohhashi discloses a sputtering target having uniform microstructure and crystal orientations with crystal grain sizes of no more than 350 μm. Ohhashi, however, fails to teach or suggest the features recited in claim 10 "each grain has a diameter in the range of 0.1 to 10 times the average grain diameter and a grain size ratio of adjacent grains is in the range 0.1 to 10". As described on page l4, lines 1 to 5 of the specification, "the grain size ratio between the adjacent grains is particularly important to be in the range of 0.1 to 10. when the dispersion of grain diameter of Nb grains is large, there are many grains different in sputtering rate to result in larger steps in sputtering between the adjacent grains." Thus claim 10 is patentable over Ohhashi for at least the above reasons.

The Office Action continues to assert that the instant grain size (presumably of claim 10) is up to 1500 μm (average grain size 150 μm x 10) which is overlapped by uniform grain sizes no more than 350 μm as taught by Ohhashi. Applicants again submit that this statement, aside from being incorrect, misses the point that Ohhashi does not suggest an average grain size less than 100 μm, or the advantages thereof in preventing dust. The above statement is incorrect at least in that the largest grain size contemplated in claim 10 would be 100 μm x 10, or 1000 μm, not 1500 μm. More importantly, however, it is the average grain size as recited that provides advantages in reducing dust. Whether or not some of the larger grains (grains up to 1000 μm) fall within the scope of the grains in the Ohhashi target is irrelevant. Neither does Ohhashi recognize that the average grain size is important in reducing dust, nor does Ohhashi disclose the specific average grain size recited in claim 10.

The APA also fails to suggest the parameters as recited in claims 1, 10 and 18, and thus fails to cure the deficiencies of Ohhashi.

Moreover, Ohhashi fails to suggest the advantages of the invention as claimed, or to even recognize the parameters important in attaining these advantages. As a result of intensive studies, the inventors have determined important parameters in solving resistivity problems of Nb liner films for Al films. Namely, the inventors have found that in high purity Nb sputtering targets, the dispersion and content of Ta in the Nb target, the Nb average grain size and the grain size ratio of adjacent grains in the Nb target, and the dispersion and content of oxygen in the Nb target are important parameters. These parameters are implemented in the sputtering targets of independent claims 1, 10, and 18, which recite, respectively, the content and dispersion of Ta, grain size parameters, and the content and dispersion of oxygen which provide an improved Nb sputtering target.

For example with respect to the Ta content and dispersion, Table 1 of the specification discloses the variation of resistivity of wiring films depending on the variation of the Ta content and the dispersion thereof. The Nb targets containing Ta in the amount of 3000 ppm or less (see nos. 1 to 4) have a relatively lower resistivity, and the Nb targets with a lower Ta content dispersion also exhibit a lower resistivity.

For at least the reasons given above, applicants respectfully submit that claims 1, 10 and 18 are patentable over Ohhashi and the APA. Independent claims 24 and 25 include the same Ta and oxygen parameter limitations of claims 1 and 18, respectively, and are thus patentable for at least the same reasons. The dependent claims depend from one of claims 1, 10, and 18, and are patentable for at least the same reasons, as well as for further patentable features recited therein.

Applicant believes that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested.

The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a

check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741. If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicant hereby petitions for such extension under 37 C.F.R. §1.136 and authorizes payment of any such extensions fees to Deposit Account No. 19-0741.

Respectfully submitted,

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